VARIABLE RATE IRRIGATION MANAGEMENT FOR PEANUT IN THE EASTERN COASTAL PLAIN

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Variable rate irrigation provides farmers with a tool to spatially allocate limited water resources while potentially increasing profits. To develop optimal management, variable rate irrigation systems will likely require rapid and reliable spatial data. We conducted variable rate irrigation experiments on peanuts (Arachis hypogaea) to evaluate methods of obtaining spatial irrigation management data.

These experiments were conducted under the variable-rate, center pivot irrigation system developed by the USDA-ARS at Florence, SC. The irrigation system covers approximately 6-ha; it is a 137-m long three span commercial center pivot that had been modified to provide site-specific irrigation applications. The pivot was divided into thirteen 9.1-m segments along its length. The pivot was designed to apply seven water rates from 0 to 12.7 mm in seven equal steps while traveling at 50% of its maximum speed. The irrigation rates were controlled by solenoids connected to a programmable logic controller (PLC). The PLC used angular position data from the center pivot controller and data tables to switch the solenoids on and off at appropriate locations throughout the field. Additional details regarding the pivot design can be found in Omary et al. 1997.

For this experiment, treatments consisted of 4 irrigation application rates with induced crop water stress initiated at 4 crop growth stages, imposed on 4 soil mapping units. Treatments were arranged in randomized complete blocks with 4 replicates for each treatment. The four irrigation application rates were 0, 33, 66, 100% of calculated crop evapotranspiration (ET). Crop ET was calculated using crop coefficients (Allen et al. 1998) multiplied with the calculated reference ET (Walter et al. 2000). A simple water balance of the past 7 days was used to initiate irrigation. When the accumulated crop ET exceeded the previous 7-days irrigation and rainfall by more than 12.5 mm, irrigation was applied proportionally to the treatments.

In 2005, the growth stages that were used to induce crop water stress; stresses were induced at 0-5 weeks, 6-10 weeks, 11-15 weeks, and 16-20 weeks after the planting date. In 2006, crop water stresses were induced at growth stages 0-10 weeks and 10-20 weeks after each of two planting dates. In both years, once a crop water stress rate was initiated on a treatment, the treatment continued to be stressed until it was harvested.

Within the growing season, canopy temperature and normalized difference vegetative index (NDVI) measurements were collected at selected intervals. Four infrared thermometers (IRT) were mounted on a bar at the front of a tractor and used to measure the canopy temperature of two rows (two IRT’s per row). Also mounted on the bar was a Crop Circle model ACS 210 canopy analyzer for measuring NDVI. All sensors were placed approximately 75 cm above the top of the canopy. A global positioning system unit was mounted on the tractor to allow for the data to be geo-referenced.

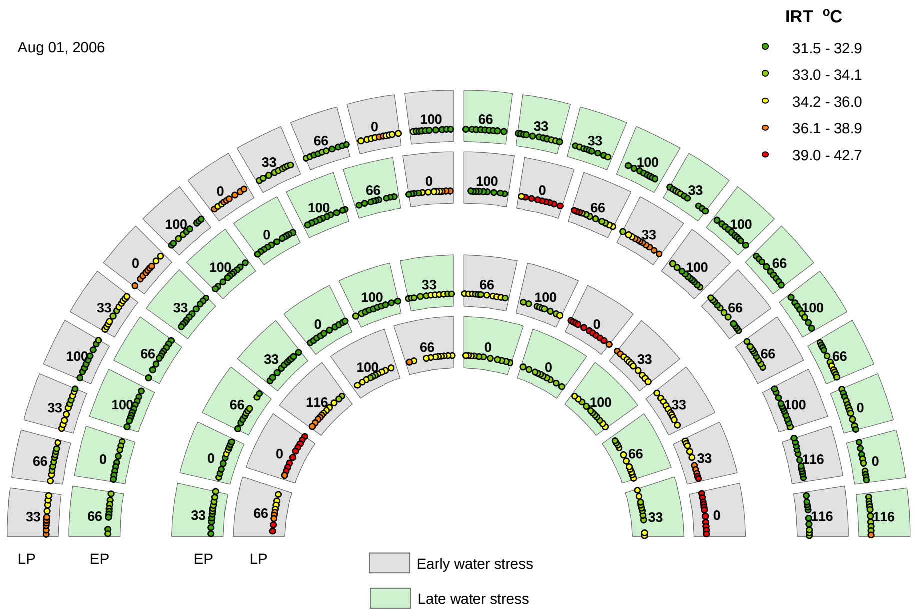

Figure 1. Spatial crop canopy temperature measured uing infra-red thermometers on August 1, 2006 for the irrigation and water stress treatments.

Preliminary results indicate that vegetative-index sensors adequately determined spatial canopy biomass, suggesting the possibility of using these data for predicting short-term site-specific evapotranspiration (data not shown). The infra-red thermometers identified field areas experiencing water stress, indicating they could be used to identify field areas requiring irrigation (figure 1).

REFERENCES

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